

## **METHOD OF USE OF CHLORINE DIOXIDE AS AN EFFECTIVE BLEACHING AGENT**

**CROSS-REFERENCE TO RELATED APPLICATIONS:** This application is a non-provisional application of U.S. Serial No. 60/481,481, filed October 8, 2003.

**STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT:**  
NONE

### **DESCRIPTION**

#### **[Para 1] FIELD OF THE INVENTION**

**[Para 2]** The present invention relates to methods of use of chlorine dioxide as a bleaching agent in laundry and warewash applications.

#### **[Para 3] BACKGROUND OF THE INVENTION**

**[Para 4]** Bleaching agents are regularly used in the laundry and warewash industries to enhance the appearance of the items being washed. Typically hypochlorite or peroxygen compounds are used as bleaching agents in laundry and warewash industries.

**[Para 5]** A wide variety of hypochlorite and hydrogen peroxide bleaching agents exist on the market that are used in laundry and warewash. These products work in a satisfactory manner but have a wide range of limitations including being temperature and pH sensitive, also these products are harsh to fabrics and are unstable which limits shelf life.

**[Para 6]** The ability to use a bleaching agent over a wide range of temperatures and pH is advantageous because it allows for simpler cleaning

processes and simpler equipment. The bleaching agent's ability to be used in varied temperatures and pH will simplify the cleaning process because there is no need to monitor or have equipment to monitor the cleaning process in order to determine the proper time to add the bleaching agent. Further, the lack of dependency on pH allows the use of the bleaching agent in direct contact with the detergent where the currently used bleaching agents that are pH sensitive are rendered ineffective in alkaline conditions (in the case of hypochlorite) or mild conditions (in the case of hydrogen peroxide) and therefore must be added separately from the detergents. This requires an extra step in the cleaning process. The most important advancement of the current invention is that it allows the bleaching step in the washing process to be performed at almost any time during the washing process without becoming ineffective like the bleaching agents currently used in the market.

[Para 7] In addition, chlorine dioxide has a very favorable environmental profile, as its use does not result in the generation of halogenated organic materials, such as trihalomethanes.

[Para 8] The use of chlorine dioxide also allows for another surprising benefit. When it is used with items soiled with chlorhexidine gluconate it does not set the chlorhexidine gluconate forming a permanent discoloration. Chlorhexidine gluconate is a sanitizer and disinfectant which is used widely in the healthcare industry. When an item soiled with chlorhexidine gluconate is washed and contacted with hypochlorite, the chlorhexidine gluconate is set and forms a discoloration, which is permanent. The use of chlorine dioxide as a bleaching agent eliminates this problem by not setting the chlorhexidine gluconate and therefore no discoloration occurs.

[Para 9] The present invention allows for the use of a bleaching agent in a wide range of temperatures and pH's especially in colder temperatures and lower pH's where existing bleach agents are ineffective. The ability to work effectively under a wider range of conditions eliminates the need for additional equipment to control the washing systems pH or the water temperature. The loss of effectiveness of a bleaching agent is crucial because there is only a limited time period that a bleaching agent should be in contact with cloth

because if it is used for an extended period of time it will start to damage the cloth. The use of chlorine dioxide not only eliminates the need for extended periods of contact because of less than optimum cleaning conditions but also if there is extended contact between the chlorine dioxide and the item the chlorine dioxide is not harmful to cloth as the current bleaching agents on the market.

#### **[Para 10] SUMMARY OF THE INVENTION**

**[Para 11]** The present invention provides a method for using a bleaching agent which is not limited by the pH of the wash solution or the temperature of the wash solution. The bleaching agent can be used simultaneously with a surfactant without any adverse effects on the bleaching effect because of the pH level of the wash solution. The present invention also allows for the use of a bleaching agent with a more moderate temperature in the washing solution while not affecting the integrity of the items being washed which is significant when washing cloth or other fibers because it keeps from degrading or wearing the fibers.

**[Para 12]** The present invention further allows for the use of a bleaching agent on fabric stained with chlorhexidine gluconate without setting the stain and forming a permanent discoloration. When the current hypochlorite based bleaching agents are used on an item stained with chlorhexidine gluconate a severe brown discoloration appears where the stain was. The current invention allows for the use of a bleaching agent while not discoloring the item.

#### **[Para 13] DETAILED DESCRIPTION OF THE INVENTION**

**[Para 14]** A method of cleaning an item comprising a cleaning apparatus, employing a water source and a bleaching agent wherein the bleaching agent is a halogen dioxide composition. The method of cleaning an item wherein a halogen dioxide is used as the bleaching agent. The method where the preferred bleaching agent is chlorine dioxide.

**[Para 15]** The method of cleaning an item including a cleaning apparatus, a water source, a surfactant and a bleaching agent. The method of cleaning an item where the surfactant is a detergent system.

**[Para 16]** The method of cleaning an item where chlorine dioxide provides an effective bleaching and cleaning of the items at any temperature above 10°C but in the preferred range of 40–60°C. The method further allowing for the effective bleaching of items at any pH above 2.5. The preferred pH range of 7–10.5 allowing for the addition of the bleaching agent at the same time as the surfactant. The method includes the addition of at least 2 ppm of chlorine dioxide. The preferred range of chlorine dioxide is 20 ppm to 500 ppm. The most preferred range of chlorine dioxide is 20–100 ppm. The method includes a source of chlorine dioxide production that is effective enough to provide adequate chlorine dioxide to work as an efficient bleaching agent. The method includes the following systems of chlorine dioxide generation: sodium chlorite in the presence of an acid, 2 or 3 component generators, and through electrolytic means.

**[Para 17]** A method of cleaning an item soiled with chlorhexidine gluconate without setting the stain comprising a cleaning device, a water source and a bleaching agent. The method of cleaning an item stained with chlorhexidine gluconate wherein the bleaching agent is a halogen dioxide. The most preferred bleaching agent is chlorine dioxide.

**[Para 18]** A method of cleaning an item comprising a cleaning apparatus, employing a water source, the water from the water source passes into the cleaning apparatus where the soiled item is contained, into the water containing the item there is added a surfactant and a bleaching agent wherein the bleaching agent is a halogen dioxide composition. The bleaching agent is preferably chlorine dioxide. The surfactant is preferably a detergent system.

**[Para 19]** The method of cleaning fabric items wherein the fabric item is placed into a cleaning apparatus with a water source leading to the fabric item and a halogen dioxide is added to the water from the water source to clean and bleach the fabric item. The method further including a surfactant in the cleaning apparatus. The most preferred surfactant is a laundry detergent. The

most preferred halogen dioxide is chlorine dioxide. The method further where the halogen dioxide bleaching agent and the laundry detergent are added to the cleaning apparatus at approximately the same time.

